

Fact Sheet - North Dakota Cloud Modification Project (NDCMP)

<http://swc.nd.gov/arb>

Key Messages

- Environmentally friendly to humans and nature
 - Cloud seeding using dry ice and silver iodide are used sparingly and ***cause no negative effects to people or the environment.***
- Research-proven benefits
 - North Dakota studies indicate cloud seeding reduces crop damages from hail by up to 45 percent.
 - Numerous studies indicate cloud seeding enhances summertime rainfall by 5-10 percent.
- Cost effective
 - Based on 2019 expenditures, the project costs only 13 cents per rural and urban acre comprising the entire project area.
 - A 2019 NDSU economic study found cloud seeding on agricultural production yields at least \$31 dollars in return for every \$1 spent.
- Property damage mitigation
 - Less hail damage to crops should also translate to less damage to property. Since 1996, Canadian insurance companies have funded cloud seeding operations to reduce hail damage to homes, cars, and businesses in the cities of Calgary and Red Deer, Alberta.

Local input and control by participating counties

- Each participating county has a County Weather Modification Authority comprised of five people appointed by the county commission.
 - They are responsible for local funding and provide input into program operations.
- The State of North Dakota cost shares 1/3 of program costs; participating counties pay 2/3 of costs.

About the North Dakota Cloud Modification Project

- The NDCMP is a dual-purpose program with operational goals of rainfall enhancement and hail suppression.
 - Added rainfall and reduced hail benefit both urban and rural properties.
- Bowman, McKenzie, Mountrail, part of Slope and Williams counties are present participants in the NDCMP.
- The NDCMP starts on June 1 each year and usually ends on August 31, though extension into September is an option for each participating county.
- NDCMP radars in Bowman and Stanley operate around-the-clock during the program. Radar images are posted to the ARB website (<http://swc.nd.gov/arb/radar>) every five minutes.

History of cloud seeding in North Dakota

- Cloud seeding with ground generators was first attempted in 1951 in southwestern North Dakota.
- Aircraft became the preferred seeding delivery method in 1960.
- The NDCMP is the longest running aerial hail suppression program in the world.
 - Many countries have visited North Dakota to learn about the project and our operations.

NDCMP Evaluations

- A 13-year study of crop insurance statistics found that crop losses to hail were reduced by 45 percent in the seeded counties versus an adjacent upwind control area. Both areas (seeded and control) had virtually identical crop-loss history in the years prior to seeding.
- Multiple evaluations using various datasets show evidence of enhanced rainfall in and slightly downwind of seeded counties. Percentage increases range from the low single digits to the low teens, with typical results approximately 5 to 10 percent.
- A study of wheat yields indicated that wheat production was 5.9 percent higher in seeded counties versus adjacent counties without seeding.
- An economic evaluation by Bangsund and Hodur (NDSU) indicated that seeding produces \$28.1 to \$48.8 million in direct crop production annually, for the eight most common crops (plus alfalfa) in the seeded area. The benefit-to-cost ratios (including hail suppression effects) based on estimated average NDCMP costs range from 31 to 1 at 5% rainfall enhancement, and 53 to 1 at 10% rainfall enhancement.

Intern training and Workforce development

- ARB and the University of North Dakota have an agreement to train pilots from the UND Aviation program. This workforce development program has trained and placed 392 pilot interns on the NDCMP since 1975.
- The ARB established a meteorology internship program in 1996 and has trained 64 meteorology students since that time.
- Both intern programs offer undergraduate students an opportunity to work in their field of choice and gain valuable experience. Many of the interns return to the NDCMP in leadership roles after their intern experience.

How weather modification works – the science behind it

- Glaciogenic seeding, the method employed on the NDCMP, promotes the earlier formation of ice in cumulus clouds, thereby accelerating the precipitation process and improving the efficiency of the seeded cloud.
- Studies show that rainfall is ***slightly enhanced*** downwind of seeded areas.
- The two seeding agents used on the NDCMP are silver iodide (AgI) and dry ice.
- Microscopic silver iodide nuclei convert supercooled water in clouds to ice at warmer temperatures than other particles naturally present in the atmosphere.
- Not all clouds are suitable candidates for seeding. Suitable clouds must have a sustained updraft, be tall enough to contain supercooled liquid water (water in a liquid state at temperatures colder than freezing), and not have already produced significant ice particle concentrations.

- Hail is suppressed primarily through the concept of beneficial competition. Seeding produces earlier formation of ice in clouds leading to more “hail embryos” in the cloud. These artificially produced hail embryos compete with those naturally produced by the cloud for available supercooled water, leading to the production of more, but smaller hailstones that are better able to melt partially or completely before reaching the ground.
- Silver iodide and dry ice are used sparingly and pose no harmful effects to humans or the environment. Numerous studies in the U.S. and abroad have proven this point.
<http://weathermod.org/wp-content/uploads/2018/03/EnvironmentalImpact.pdf>